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CONTENTS.

THE FIELD EXPERIMENTS AT TOCKLAI.

BY

E. A. ANDREWS.

No. 2. THE PRUNING EXPERIMENT.

Previous reports of the progress of this experiment have been published in earlier numbers of this Journal*. In the latest of these reports, in Table I, the yields of the plots and the pruning systems adopted are given from the commencement of the experiment to the end of 1922. The following table is a continuation of the previous record, and gives the yields of the plots, in maunds of made tea per acre, and the pruning scheme carried out, for the years 1923 and 1924, and the total yield to the end of 1924.

TABLE I.

Pruning Experiment (Tocklai).

1913 Seed. 1914 Nursery. Transplanted, Autumn 1916.

1917 Original Pruning.		1922.	1923.		1924.		TOTAL.
		Pruning.	Yield.	Pruning.	Yield.	Pruning.	
Cut at 18″	Assam	2″	11·61	2″	11·20	2″	72·85
	China	2″	8·63	2″	7·30	2″	60·02
	Burma	2″	12·40	2″	12·96	2″	76·10
Cut at 12″	Assam	2″	10·62	2″	9·90	2″	64 11
	China	2″	8·73	2″	7·00	2″	54·87
	Burma	2″	10 22	2″	10·07	2″	62·94
Cut at 6″	Burma	2″	10 86	2″	12·68	2″	67·90
Cut at 4″	Assam	2″	11·36	2″	9·21	2″	56·36
	Burma	2″	10·90	2″	10·36	2″	55·58
Cut at lowest branch	Assam	¾″	10·87	2″	9·25	2″	53·79
	Burma	2″	10·67	2″	11·20	2″	55·15
Cut to 2″	Assam	2″	11·61	2″	9·25	2″	53·37
	China	2″	7·41	2″	5·30	2″	39·10
	Burma	2″	11·58	2″	10·50	2″	55·11
A Collar pruned and then pruned annually.	Assam	2″	10·88	2″	9·90	2″	48·83
	China	2″	5·19	2″	3·57	2″	25·28
	Burma	2″	9·31	2″	9·00	2″	48·98
B Collar pruned and then pruned every 2nd year only.	Assam	...	5·19	2″	3·00	Unpruned	26·76
	China	...	5·43	2″	2·73	do.	38·47
	Burma	...	8·99	2″	6·15	do.	42·97
Cut at 24″; collar pruned in 1920	Assam	6″†	5·19	4″	7·73	2″	56·14
	Burma	6″	6·96	4″	11·60	2″	68·13

†On two-year wood.

*1918—Pt. IV—pp. 129—132.
1920—Pt. II—pp. 44— 47.
1923—Pt. II—pp. 52— 64.

The first noticeable feature of the yields—a feature independent of the actual experiment—is the fact that in 1923 the Assam yielded better than the Burma, on the whole, whereas in 1924 the reverse was the case. This experience was in accord with the behaviour of other plots on the station, and is accounted for by the difference in the seasons. In 1923 the rainfall was heavy, and, during the important months of April, May and June, copious. In 1924 rainfall was short during these months and the more delicate Assam variety fell behind the Burma accordingly.

The monthly rainfall figures are given below :—

TABLE II.

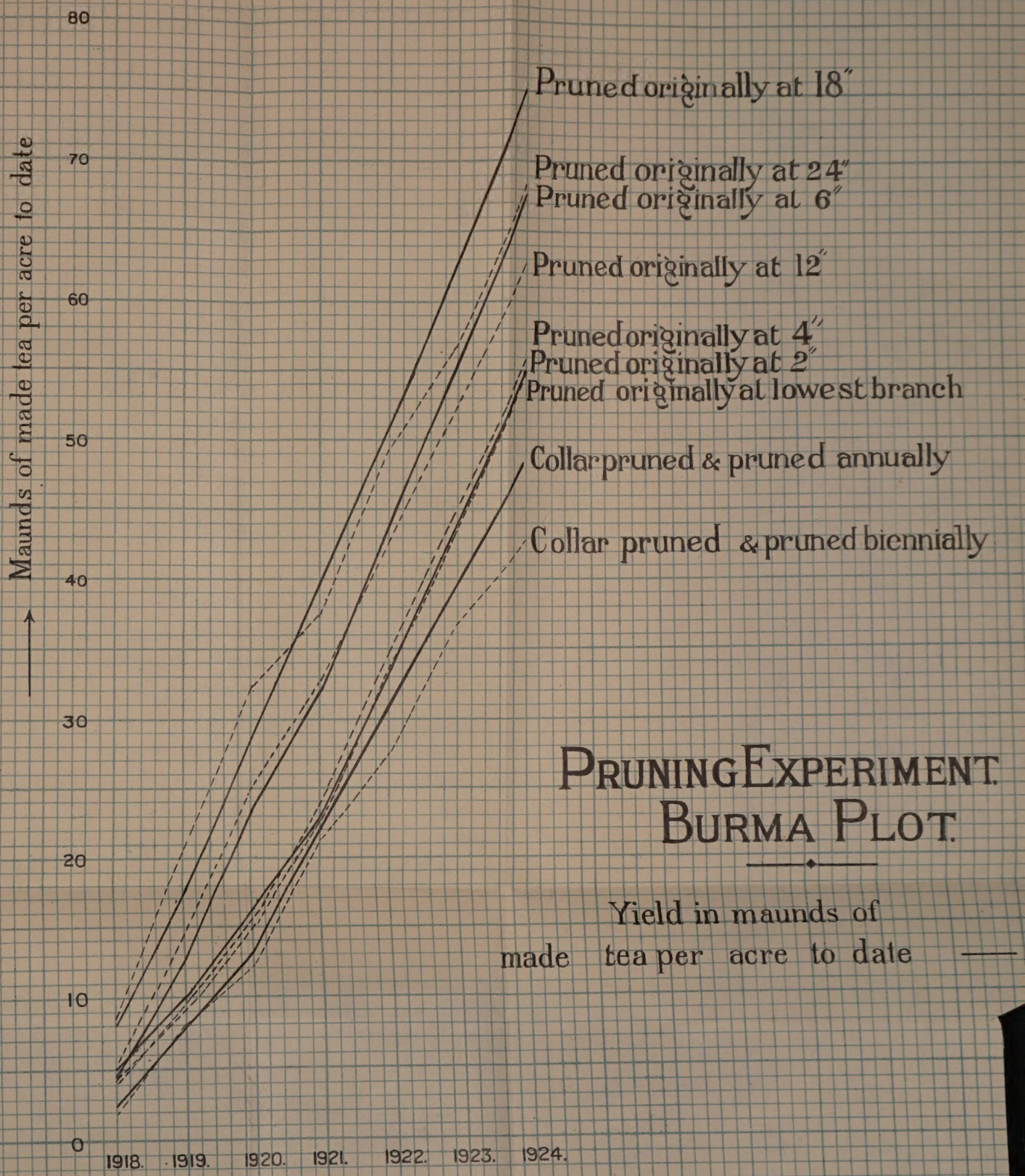
Monthly Rainfall in inches, Tocklai.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1923	nil.	2·77	0·43	10·84	11·97	20·29	18·79	17·11	14·12	3·93	1·55	0·11	100·91
1924	0·49	1·92	1·01	6·84	6·10	6·36	17·94	7·52	9·58	5·62	2·92	nil.	66·30

Such climatic variations tend to affect the results of all such experiments, and render it emphatically necessary that the experiments should be continued over a sufficient number of years to eliminate such variations, more especially when the experiments are on a small scale.

For this reason the observations contained in this report of the progress of the experiment are based not so much on what has happened year by year as on the total result at the end of the seven years for which the experiments have been carried out.

These results are of great interest, as showing, first of all, that at the end of seven years the bushes which were pruned higher to begin with are still in the lead as regards crop to date, and, moreover, that the order of yield which obtained amongst the plots in the first year is still being adhered to, and is similar throughout the different varieties. On account of this similarity



Pruning Experiment. Burma Plot.

Yield in maunds of made tea per acre to date

in behaviour with different varieties it is possible to discuss the results with reference to the Burma plot in which the series of experiments is complete. Diagram I shows the total yield, from the beginning of the experiment to the end of each successive year, for the types of pruning carried out in this plot, yields being expressed as maunds of made tea per acre.

It will be seen from this diagram, that in the first year (after the original treatment) the bushes fall into three groups as regards outturn. In one group is the two series which were collar-pruned, with an outturn of between 2 and 3 maunds per acre. In the second group lie the series which were pruned at heights varying from 2 to 12 inches, the outturns of which range between $\frac{1}{4}$ and 6 maunds per acre. The third group contains the series pruned at 18 and 24 inches, which gave an outturn of between 8 and 9 maunds per acre.

By the second year the three groups had become four ; first, the collar-pruned bushes ; second, those pruned at 2 inches, the lowest branch, and 4 inches ; third, those pruned at 6 and 12 inches ; and fourth, those pruned at 18 and 24 inches. The 24 inch pruning had gained on the 18 inch pruning by about 3 maunds an acre ; the 12 inch pruning had gained on the 6 inch pruning by about a maund an acre ; in the other groups little or no difference was observable. All the bushes cut at 6 inches and above had gone up in yield as compared with those cut below 6 inches.

By the third year the difference between the bushes cut at 6 inches and over, and those cut below 6 inches, had become much more marked, and while the 24 inch pruning had gained about a maund an acre more on the 18 inch pruning, the 6 and 12 inch pruning were now yielding at about the same rate, the latter still being ahead by the amount gained in the second year. At this point, unfortunately, the continuity of the experiment was interfered with. The series originally pruned at 24 inches was collar-pruned, and that originally cut at 12 inches was medium pruned and headed back in the centre. The effect of this treatment is clearly shown in the diagram.

With regard to the collar-pruning an interesting fact is brought out, however. When the series originally cut at 24 inches was collar-pruned "kickers" were left on the Burma bushes, but not on the Assam bushes. The result of this (apparently) was a yield of 5.26 maunds of made tea per acre from the Burma against a yield of only 2.21 maunds from the Assam. When the Burma bushes were collar-pruned in 1918, without leaving "kickers," the yield averaged 2.37 maunds. It would therefore appear that leaving "kickers" had been an advantage so far as crop is concerned. The medium pruning and centering of the series originally pruned at 12 inches produced a drop in crop of ¾ of a maund per acre, as compared with the series originally pruned at 6 inches, but of about 4¼ maunds per acre as compared with the series originally cut at 18 inches. At this time the series pruned at 2 inches, the lowest branch, and 4 inches were well behind, and very little ahead of the collar-pruned series.

Since the fourth year (1921) the behaviour of the series in which the treatment originally laid down has been followed out consistently has been consistent. The series originally pruned at 18 inches has yielded steadily, and maintained the lead obtained at the end of the fourth year. The series originally pruned at 6 inches has behaved similarly, and, for the last three years, has given practically the same crop as the former series, from a much lower frame. The series pruned at 2 inches, the lowest branch, and 4 inches show practically no difference among themselves, though they have fallen slowly but steadily behind the two former series. The collar-pruned series (pruned annually) is falling still further behind, but maintaining a steady outturn. The results of the series which was originally collar-pruned, and is left unpruned every year, are unfortunately vitiated by the "drainside effect" referred to in previous reports. The two series which were cut back at the end of third season (that originally cut at 24 inches, and that originally at 12 inches) have both gone back in the scale.

A discussion of the results obtained to date is of interest, and in this connection reference should be made to the following table :—

TABLE III.

Loss in crop in maunds of made tea per acre, over seven years, produced by the different treatments as compared with pruning originally at 18 inches and subsequently top-pruning each year.

Treatment.	Assam.	China.	Burma.
Collar-pruned and pruned annually	24·02	†34·74	27·12
,, ,, ,, biennially	†46·09	21·55	†33·13
Pruned to 2 inches	19·48	20·92	20·99
,, ,, lowest branch...	19·06	...	20·95
,, ,, 4 inches	16·49	...	20·52
,, ,, 6 ,, ...	...	...	8·20
,, ,, 12 ,, ...	8·74	5·15	13·16
,, ,, 24 ,, ... and collar-pruned at end of 3rd year	16·71	...	7·97

The series originally pruned at 18 inches has so far yielded, in the case of the Assam variety, 72.85 maunds per acre, or 10.4 maunds per acre per annum ; in the case of the China variety, 60.02 maunds per acre, or 8.6 maunds per acre per annum ; and in the case of the Burma variety, 76.10 maunds per acre, or 10.9 maunds per acre per annum.

A loss in crop has been experienced, in all three cases, by all the other treatments.

The series originally cut at 12, 18, and 24 inches, in spite of coming back on them, have still given a bigger yield to date, and therefore been a more paying proposition, than the series cut low originally. It must be remembered that the series originally cut at 24 inches was collar-pruned at the end of the third year of cropping, so that this series now also possesses the advantage of having frames built up from the ground. In this connection, also, the Burma variety appears to have withstood the heavier cutting better than the Assam, which is in accord with experience (though leaving " kickers " may have helped).

†Drainside lines.

The series originally cut at 6 inches (represented, unfortunately, only in the Burma plot) is next best in outturn to the series originally pruned to 18 inches, and, as will be seen later, the bushes have already attained a spread almost equal to that of the latter, on a much lower frame.

Below 6 inches no advantage has accrued from cutting higher than 2 inches—rather the reverse, owing to the opportunity afforded to termites by the snags formed, and the loss in crop due to the original low pruning has been considerable.

Collar-pruning has resulted in a still further decrease in crop, plus a higher percentage of deaths as previously recorded.

The following table gives the average diameter of the plucking surface of the bushes in the various series measured on the 28th August 1925. The area of plucking surface on the bushes originally pruned at 6 inches is noteworthy. Likewise is it noticeable that the bushes originally pruned at 2 inches have a spread comparable to that of the bushes cut at 12 inches, and subsequently medium pruned and centred, although the frames of the latter are higher. In this respect, also pruning at the lowest branch, and at 4 inches, has given no advantage over pruning at 2 inches.

TABLE IV.

Diameter of Plucking Surface.

Original Treatment.	Assam.		China.		Burma.	
	ft.	ins.	ft.	ins.	ft.	ins.
Collar-pruned and pruned annually ...	3	6	2	9½	3	6
Pruned to 2 inches	3	8	3	3	3	8½
„ „ lowest branch	3	7	...		3	7½
„ „ 4 inches	3	5	...		3	9
„ „ 6 „	...		...		4	5½
„ „ 12 „	3	9	3	5	3	5
„ „ 18 „	4	8	3	10	4	6½
„ „ 24 „	2	11½	...		3	3
Collar-pruned and pruned biennially ...	3	5	2	11½	3	3

SUMMARY.

In the initial stages of the experiment, it was noted that the percentage of deaths was reduced by cutting at 2 inches as compared with cutting at the collar, while there was less loss in

crop and no loss in spread of the frame. Cutting higher than 2 inches was no advantage at any height below 6 inches, rather the reverse, as the bushes came away from the 2 inch mark and left a snag in the centre to form a harbourage for termites. Bushes cut at 6 inches came away from that level, without forming a snag, with loss in crop comparable with that produced by cutting to 2 inches. Cutting at 12 inches gave slightly less drop in crop (about ½ md. per acre), and the bushes came away below the pruning, leaving many snags for termite attack. Bushes cut at 18 inches came away from the pruning level, with few snags and good crop. Cutting at 24 inches gave a similar outturn, but there was much die-back.

To date the yields justify cutting at 18 inches, since in all cases this series has given the biggest outturn. Cutting at 6 inches runs it close, for although the total yield to date is not yet equal to that of the tea originally pruned at 18 inches, yet it is now giving the same yield, on a bush with the same plucking surface on a lower frame. Cutting at 24 inches, and collar-pruning after three years, appears to be a paying proposition also, as the yield has been equal to that of the bushes originally cut at 6 inches, while the frames of the bushes have now been built up from the ground. Cutting at 12 inches, and taking back to 14 inches, with centring, at the end of three years, has not been an unqualified success. The outturn is below that of the bushes originally cut to 6 inches, while the area of the plucking surface is small, and supported on frames which may need to come down, and be difficult to prune on. Below 6 inches there is no point, at Tocklai, in cutting higher than 2 inches, as the results are the same in all respects as if the bush had been cut at 2 inches, save for the fact that damage by termites may be encouraged by cutting higher. Collar-pruning is distinctly less advantageous, in every way, than cutting at 2 inches.

The immediate interest of this experiment now centres in the possible behaviour of the bushes originally cut at 24 inches, and subsequently collar-pruned, as contrasted with that of the bushes originally cut at 18 and 6 inches.

THE CONCENTRATION OF LIME-SULPHUR SOLUTION.

BY

A. C. TUNSTALL.

It is sometimes said that in spite of considerable expenditure no disease of the tea plant has ever been eradicated. It is a true statement and may be extended to embrace all diseases. Total eradication of any disease is out of the question except in very special cases and even then the expenditure involved is generally enormous. Occasionally however the damage done by a particular disease is sufficiently large to warrant such expenditure.

The tea industry in common with other agricultural pursuits annually suffers great loss from the ravages of pests and blights. Individually most of these pests and blights do not involve sufficiently serious losses to warrant heavy expenditure in their treatment but collectively they are responsible for an annual loss on an average of at least half a maund of tea per acre. At least half of this loss can be avoided by the general application of a suitable spray fluid each cold weather. The most generally useful spray fluid for this purpose is undoubtedly Lime-sulphur solution and an increasing number of gardens are adding general applications of this solution to their cold weather routine.

Planters often desire information as to the strength of Lime-sulphur solution required for various purposes. As a general rule the best solution to use is the strongest it is possible to apply without injuring the bushes.

The following formula for the preparation of Lime-sulphur solution is not the best one from a purely chemical point of view but it has the great advantage of yielding a solution of remarkably constant strength in spite of the little inaccuracies commonly associated with the work of tea garden coolies.

Quicklime	...	...	20 lbs.
Sulphur	...	...	22½ lbs.
Water	...	...	50 gallons.

The lime should be put into a drum of 50 gallons capacity and slaked by adding water gradually. When it is fully slaked,

add about 30 gallons of water, and bring to the boil. When it is boiling add the sulphur gradually, stirring vigorously during the whole time, and when all the sulphur has been added pour in boiling water to the 50 gallons mark. Boil for an hour longer, keeping the volume at 50 gallons by adding boiling water.

The preparation of Lime-sulphur solutions of higher concentration requires a degree of care, impossible to obtain under general tea garden conditions. The above-mentioned solution has a specific gravity of about 8° Beaume.

Many gardens use the ready prepared concentrated solution sold by various firms in Calcutta. These solutions differ in concentration and should be purchased with a guarantee of a definite specific gravity. The dilution required varies with the specific gravity which is an approximate measure of the concentration.

The degree of dilution required may be obtained from the following table:—

Reading of Hydrometer in Cold Solution.		Amount of water to be added to one part of the concentrated solution.				
		Cold Season.		Growing Season.		
In degrees Beaume.	In specific gravity.	Heavy-pruned tea without buds.	Heavy pruned tea with buds and all other tea.	Ordinary tea.	Heavy-pruned and young tea.	Nurseries.
8	1·057	2	3	6	7	8
9	1·064	2¼	3¼	6½	7½	8½
10	1·072	2½	3½	6¾	7¾	9
11	1·080	2¾	3¾	7½	8½	9¾
12	1·088	3	4	8	9¼	10¾
13	1·096	3¼	4½	8¾	10¼	11¾
14	1·104	3½	5	10	11½	12¾
15	1·113	3¾	5⅛	10½	12¼	14
16	1·121	4	5⅜	11¼	13¼	15
17	1·130	4¼	6	12	14	16
18	1·138	4½	6¼	12¾	14¾	17
19	1·147	4¾	7	13¾	16	18¼
20	1·157	5	7½	14¾	17¼	19¾
21	1·166	5¼	8	16	18½	21½
22	1·176	5½	8½	17	20	22¾
23	1·185	6	9¼	18¼	21½	24¼
24	1·195	6½	9¾	19½	22¾	26

Reading of Hydrometer in Cold Solution.		Amount of water to be added to one part of the concentrated solution.				
		Cold Season.		Growing Season.		
In degrees Beaume.	In specific gravity.	Heavy-pruned tea without buds.	Heavy pruned tea with buds and all other tea.	Ordinary tea.	Heavy-pruned and young tea.	Nurseries.
25	1·205	7	10½	20¾	24½	27¾
26	1·215	7½	11½	22½	25¾	29½
27	1·225	7¾	11¾	23½	27½	31
28	1·235	8½	12½	24½	28¾	32¾
29	1·245	8½	12¾	25¾	30	34½
30	1·256	9	13½	27½	31¾	36½
31	1·267	9¼	14	28	32¾	37½
32	1·278	10	15	30	35	40
33	1·289	10¼	15½	31	36	41½
34	1·300	10¾	16½	32¾	38	43½
35	1·312	11½	16¾	33¾	39½	45

Beaume Hydrometers for use with liquids heavier than water may be obtained in Calcutta at about Rs. 7 each.

The amount of diluted solution required per acre of course varies with the size of the bushes and the means employed in the application. In the latter respect the nozzle plays an important part. The size of the aperture of the nozzle should be such that the spray is as fine and mist-like as possible. A large aperture and low pressure produces a coarse spray. The finer the spray the more even its distribution.

The following figures are only approximate but they will serve as a rough guide to enable planters to estimate their requirements.

Unpruned well grown tea—200 to 300 gallons per acre.
High pruned well grown tea—150 to 200 gallons per acre.
} Applied with an I. T. A. 4 nozzle attachment.

Low pruned tea—100 to 150 gallons per acre.
One year old well grown seedlings—40 gallons per 1,000 plants.
} Applied with an ordinary single nozzle.

LECTURE COURSES AT TOCKLAI—1925.

General.

This article contains a very brief summary of the lectures that are to be delivered during November and December. In addition to the lectures, every afternoon demonstrations are given either in the field or in the laboratories to exemplify that which has been discussed in the lectures.

Chemical.

The first lecture of the courses is one that deals generally with the relationship of the plant to its sources of food-supply, the atmosphere, and the soil, and the manner in which the plant lives and obtains its food is described.

The general properties of soil are discussed and what constitutes a soil, and wherein it differs from a collection of small mineral particles, how it is formed and how it is likely to vary in fertility.

A classification of soils is given in regard to their methods of formation showing how different types of soil may be expected to result by the different means of formation.

The different classes of soil are then discussed in somewhat more detail particularly in regard to the size of the particles and the influence that this has on some of the properties generally connected with soil tillage.

The space in between the soil particles and how this is occupied both by soil water and by the soil atmosphere and how these affect the general condition and fertility of the soil is an important matter that receives consideration.

The micro-organic population of the soil is also dealt with in a general manner.

This is followed by lectures dealing with the peculiar properties of sand, silt, clay, and organic matter.

The object or reason for mechanical analyses of the soil and also the methods employed are discussed and demonstarted,

and it is shown how soils are classified in a first approximation according to their mechanical analyses, which also classifies them roughly according to some of their more important physical and chemical properties.

Other lectures deal particularly with soil water and drainage. The optimum water content of soils is discussed and it is shown how this varies with the different classes of soil. The reason, possibilities and limitation of gravitational drainage are discussed, as also the various means whereby water is lost to the soil such as by percolation, transpiration and evaporation. At the same time some of the properties that are associated with the upward lift of water in a soil are dealt with, and it is shown how this upward lift is dependent not only on the soil texture but also on the position of the permanent water-table, and how it is that with some soils the danger of drought is much more to be feared than with other soils. The means available for the prevention of drought are explained.

The chemical composition of the soil is dealt with and particular attention is directed to the nitrogen, lime, potash, phosphoric acid and soil acidity and the relationship of these factors to the provision of a good tea soil.

The importance of the organic matter of the soil in controlling the fertility of the soil in regard to tea culture is exemplified.

Typical chemical analyses of soils of various kinds are discussed and the variation in the analyses is correlated with the variation in the fertility of the soil with regard to the tea plant.

Another very important matter that receives attention is that of cultivation. The reason for cultivation and what it is expected to effect. It is shown that cultivation properly done increases the amount of plant-food available. On the other hand it is pointed out that improper cultivation results in loss of fertility in the soil and that if improper methods are carried on for sufficient length of time the soil becomes a comparatively poor one in spite of the fact that there is a large reserve of potentially available plant-food present.

Cold weather cultivation, trenching, deep-hoeing, forking, and rains cultivation all receive special consideration with the idea of explaining the reason for these operations so that they shall no longer be controlled by a rule of thumb but that they may be utilised as conditions require and allow.

Two lectures of interest are those devoted to the question of manuring,—what manures should be used to supply the various plant-foods that are required and how these can best be obtained, and the effect produced on the bush by the use of the different plant-foods *e.g.*, :—

Nitrogen is the chief factor in producing vegetative growth :

Phosphoric acid by itself seldom produces increased crop but is useful in maintaining the regular growth and development of the bushes :

The use of potash increases the plant's resistance to many diseases. It helps to produce strong wood and is particularly useful on sandy soils.

The use of lime on tea soils is also discussed and how this particular manure should be used.

The selection of manures together with a method for comparing the prices of the individual substances purchased, together with suggestions for useful and suitable manurial treatment for the different kinds of soil is also dealt with, and the object of the use of a rotation scheme of manuring, explained.

The method of application of manures is also dealt with.

One lecture is devoted to pruning and plucking, to a discussion of how these two processes affect and influence the growth and general conditions of the tea plant, how they can be used towards the production of a greater crop and how also they can be misused towards the weakening and general debilitating of the bushes.

The different types of pruning are discussed.

Three lectures are devoted to the manufacture of tea. These deal with the composition of the tea leaf as it is grown under different conditions, and a general outline of some of the processes connected with the manufacture of black tea is dealt with and how this differs from green tea. A description is given of how the different treatment the tea bush receives can affect the composition of the leaf.

The various processes of manufacture are discussed to emphasise some of the methods for obtaining better control of the processes. What is required in the final tea and how changes in the processes affect changes in the finished product are dealt with.

Entomological.

Three lectures of one hour each are assigned to this subject, which is dealt with under three heads, to each of which one lecture is devoted. These are as follows :—

Lecture I—Insects
,, II—Insects and plants
,, III—Insect Control.

Lecture I opens with an account of the characteristics by which insects can be distinguished, and a general description of their external and internal anatomy. The structure and functions of the various organs of the body are then described, with particular emphasis on those organs, in their various modifications, which are of importance as determining, or being adapted to, peculiar habits and characteristics ; and on peculiarities and modifications of structure which are of importance from the point of view of insect control. The relationships existing between structure and habit, and the manner in which deductions with regard to the latter may be deduced from the former, is then elaborated.

This is followed by an account of the biology of insects—their development, habits, mode of life, etc. The two main types of life cycle are described in detail, and their inter-relationships and modifications, and their relative importance from the economic standpoint, discussed.

The lecture closes with an outline of the salient points in connection with the more important pests of tea, discussed with reference to the general principles enunciated earlier in the lecture.

Lecture II deals with the relationships between insects and plants. It is shown that insects can be arranged in classes, not only according to their structure but also according to their habit of feeding, and that this letter is of considerable importance in determining the relationship between an insect and any particular plant. The differences between the three classes of herbivorous, carnivorous, and scavenging insects are described, and illustrated, by reference to insects connected with tea. The further subdivisions of insects into the two great classes of biting and sucking insects, and its importance in connection with the relations between insects and plants, and insect control generally, is then discussed. This leads up to a description of the relationships actually found to exist between insects and plants, and the manner in which peculiarities, or modifications, in structure and habit of the insect, on the one hand, and peculiarities and modifications in structure and habit of the plant, on the other hand, may affect the one or the other.

The actual results of these inter-relationships are then considered, and the effect of insect attack on plants discussed. It is shown that this depends on—

(1) The nature of the insect
(2) The habit of the insect
(3) The nature of the plant
(4) The part of the plant attacked
(5) The stage of growth at which the plant is attacked.
(6) The condition of the plant.

and each factor is discussed in detail in its various aspects.

Finally, it is shown how, in the case of cultivated plants, the various cultural operations introduce new factors and operate

on existing factors, affecting the plant favourably or the reverse according to circumstances.

Lecture III deals with the subject of Insect Control, to which both of the preceding lectures have been preliminary. It is first shown that in any case of insect attack on a plant there are three main factors to consider :—

the insect
the plant, and
the environment.

These three factors all react, the one on the other, the reaction which it is wished to control being that of the insect on the plant. Since all are in continuous and contemporaneous operation, no one factor can be considered without reference to the other two, and all problems of insect control therefore necessitate a comprehensive enquiry into :

(1) The nature, life-history, habits, etc. of the insect.

(2) The nature and economy of the plant, and all operations connected with its cultivation and propagation.

(3) The effect upon the insect and the plant of all possible varieties of the environmental conditions, both those which occur naturally, and those produced artificially by cultural and other operations.

This survey of the factors at work shows that there are three conceivable ways in which control may be possible.

(1) by direct attack on the insect

(2) by direct treatment of the plant

(3) by modification of environmental conditions so as to affect the reactions between the insect and the plant either

(*a*) by its effect on the insect or

(*b*) by its effect on the plant.

The measures adopted for direct attack on the insect are then described, under the three main headings of collection of the insects, the use of insecticides, and the introduction of predators and parasites, all of which are discussed in detail with regard to their character, mode of application, and modification to suit different combinations of circumstances.

A discussion of methods adopted, and in course of trial and elaboration, for dealing with the problem by direct treatment of the plant, follows, in which the subjects of selection and breeding of resistant varieties, injection of substances into the plants, modification of pruning methods, and in the method of collecting the crop, and so on, are discussed. The lecture closes with a discussion of the problem of modification of environmental conditions. These are considered under three main heads :

Climatic conditions

Tropical conditions

Soil conditions

and the methods available for the modification of each, the manner of their application, and the direct and indirect results of the various operations, with their inter-relations, explored.

In the laboratory a series of specimens selected to illustrate the points brought out in the lectures is arranged, and these are exhibited and described with reference to what the members of the course have already been told. A series of specimens of the different pests of tea is also exhibited and explained, and the peculiarities of each, and their relationship to each other, to the tea bush, and to problems of control, elucidated by examination of the actual specimens.

Mycological.

The Course consists of three lectures of one hour each supplemented by demonstrations in the laboratory. The first two lectures deal particularly with the plants and fungi. The structure of green plants is discussed as it is necessary to have a knowledge of this before it is possible to understand the action of fungi on the tea bush. The various

organs such as the leaves, stems, and the roots are discussed and their peculiarities of structure are shown.

The differences between the fungi and green plants are shown to be largely determined by their relationship to light.

Various differences in the structure and growth and development between green plants and fungi are discussed and it is shown how very considerably they differ owing to their different methods of living. They require different types of food substances, and it is pointed out that many fungi live on organic matter—some on dead and some on living tissues. It is with those fungi that live on living tissues these lectures are particularly concerned.

The classification of different fungi is dealt with and it is pointed out that this classification is based on the kind and manner of formation of the fruit bodies.

Most of the fungi which interest tea planters are found to belong to two particular groups, and these two groups receive particular attention.

The life histories of some of the most important fungi are described in detail. Owing to lack of time it is impossible to describe all the commoner diseases of tea but a condensed schedule of the life histories of the commoner diseases of the tea bush will be given to each member attending the Courses.

The manner in which fungi spores are spread and distributed by different agencies are discussed.

Another group of plants somewhat similar to the fungi are the algae, to which group red rust belongs. These are dealt with.

The algae are in certain cases connected with lichens and these consequently receive attention during the Course lectures.

The chemical and physical re-actions of the plants are discussed and some of the simpler forms of the fungal life.

The tissues of various portions of plant are not all made of the same substances and the disease producing fungi differ in their ability to attack these different tissues and a study is made of the manner in which particular fungi attack the tissues of the older plant in order that some idea may be formed of the mode of infection of a plant by a fungus.

Having discussed the life history of fungi and their manner of infection to the plant, a discussion of suitable treatment of the different diseases is made whereby it is sought to show how the different treatment deals with the different diseases.

The use of fungicidal sprays in disease control and what to do when an outbreak of serious disease is discovered in the case of stem and leaf diseases and also in the case of root diseases is dealt with in particular, also the desirability for the general sanitation of the tea bush is emphasised.

One lecture is devoted to the preparation and application of the various spray fluids and recommendations for the treatment of specific diseases with the different spray fluids.

In addition to the three lectures, demonstrations are given in the laboratory during three afternoons of the week.

Those attending the Courses are asked to bring or send in advance specimens of diseases of special interest to themselves. These are fully discussed during the demonstrations.

Meteorological. One lecture is devoted entirely to meteorology and the study of the climatic conditions that pertain in the tea districts.